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COLONY-SITE AND NEST-SITE USE BY COMMON GRACKLES IN NORTH DAKOTA

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Abstract.—We searched 638 quarter sections (0.8 × 0.8 km) for Common Grackle (*Quiscalus quiscula*) nesting sites in Benson County, North Dakota, in 1989 and 1990. We found 3596 active nests in 202 colonies on 177 quarter sections. Colonies in shelterbelts next to inhabited farmsteads were found at greater than expected frequencies ($P \leq 0.05$), whereas colonies in vegetation associated with potholes and miscellaneous habitats (woods, ravines, railroad easements, and lakesides) occurred below expected frequencies. Nest sites in stands of vegetation >100 m from farmstead residences occurred less frequently than expected ($P \leq 0.05$). Within colonies, nest sites in blue spruce (*Picea pungens*), Siberian elm (*Ulmus pumila*) and black poplar (*Populus nigra*) were found at greater than expected frequencies ($P \leq 0.05$) according to these species' availabilities, while green ash (*Fraxinus pennsylvanica*), American elm (*Ulmus americana*), and Russian olive (*Elaeagnus angustifolia*) were used below expected frequencies. The Common Grackle's preference for shelterbelts near inhabited farmsteads affected the physical and vegetative characteristics of colony sites and nest sites; with the exception of hawthorn (*Crataegus rotundifolia*), colonized stands had species compositions typically found in multi-rowed farmstead shelterbelts in North Dakota. *Received 7 Feb. 1995, accepted 25 Aug. 1995.*

The North Dakota population of breeding Common Grackles (*Quiscalus quiscula*) has more than doubled to 768,000 pairs (Nelms et al. 1994) from initial estimates made in 1967 (Stewart and Kantrud 1972). In the northern Great Plains, a region of intensive agricultural production, rows of shrubs and trees (shelterbelts) may be important nesting habitats for Common Grackles (Yahner 1982). In South Dakota and Minnesota, more than 50% of the birds nesting in multi-rowed shelterbelts were Common Grackles (Field 1971, Yahner 1982). North Dakota was historically dominated by prairie grasslands, and Common Grackles were restricted to nesting in the vegetation of riparian habitats, wetlands, and towns (Coues 1878). Recent plantings of numerous shelterbelts for agricultural and other purposes (e.g., insulation and beautification of farmsteads) may have enhanced the Common Grackle's access to prime nesting sites in North Dakota.

Records from the Cornell Laboratory of Ornithology indicate that coniferous and deciduous trees are most frequently used by grackles nest sites with 24% and 14% of the nests, respectively (Maxwell et al. 1976).

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However, quantitative comparisons of nest-site use by Common Grackles have been made only by Field (1971) and Yahner (1982). These studies involved nest-site use at the substrate level, and broader perspectives of colony-site use and habitat use were not investigated.

Our objectives were to determine habitat, colony-site, and nest-site use by Common Grackles in northcentral North Dakota. Our data on the preferred nesting sites of Common Grackles may benefit participants in shelterbelt-planting efforts (e.g., the North Dakota Centennial Tree Planting Project) who wish to avoid creating favorable nesting habitat for this species because it can damage crops.

STUDY AREA AND METHODS

Benson County is located in northcentral North Dakota in the northeastern Drift Plain Physiographic Region (Stewart 1975). The topography is flat to gently rolling, consisting of croplands interspersed with numerous potholes, temporary wetlands, and shelterbelts. The county is primarily cropland (74%). The remaining land area is dedicated to rangeland and pasture (17%) and woodlands, federal non-croplands, and other lands (9%). About 97% (5666 ha) of Benson County's native woodlands are in the east in the Devils Lake and Wood Lake regions. Water bodies > 16 ha represent 2% of the county. Siberian elm (*Ulmus pumila*) is the main species found in single-row shelterbelts. Multi-row shelterbelts consist of various combinations of species including Siberian elm, caragana (*Caragana aborescens*), green ash (*Fraxinus pennsylvanica*), boxelder (*Acer negundo*), plains cottonwood (*Populus deltoides*), and blue spruce (*Picea pungens*). In low-lying areas, willow (*Salix* spp.), quaking aspen (*Populus tremuloides*), and plains cottonwood grow naturally. Hawthorn (*Crataegus rotundifolia*), chokecherry (*Prunus virginiana*), and wild plum (*Prunus americana*) occur frequently in pastures and uncultivated areas. Large stands of bur oak (*Quercus macrocarpa*) are found in the hill region surrounding Devils Lake Basin.

Long-term average precipitation is 44 cm, with 72% of it falling in April–September (North Dakota Agricultural Statistics Serv. 1990). In May, the peak breeding period for Common Grackles in Benson County, the average temperature is 12°C. Average dates of first and last frosts (0°C) are 13 September and 23 May, respectively.

From 18 May through 10 June 1989–1990, we located active nests by systematic walk-through surveys on 638 randomly selected quarter sections (0.8 km × 0.8 km). All vegetation capable of supporting a Common Grackle nest was searched. Surveys were made daily from 09:00 to 18:00 h. A nest was considered active if it contained eggs, nestlings, or was defended by adults. An extendable pole with a mirror was used to check for eggs and young. All nest sites were marked with colored mylar tape attached at the base of the nesting substrate.

We defined a nest site as the substrate on which a nest was built. A colony site was the stand of vegetation in which a nest occurred, with a stand being any continuous body of vegetation separated from all other such bodies by at least 50 m. We selected 50 m because colony sites were usually not defended at distances >50 m and thus could be considered distinct from other stands (Gutzwiller and Anderson 1987).

At each colony site, five nest sites and five potential nest sites (controls) were randomly selected. Controls included vegetation >1 m in height and capable of supporting a nest. The controls were selected by randomly drawing numbers and converting these numbers to meters on an *x-y* axis defined by the length and width of the colony site. If the coordinates did not fall on a suitable control, coordinates were redrawn until five controls were chosen. When ≤5 nest sites were present at a colony site, data were collected for all nest sites. We recorded plant species and trunk diameter at breast height (DBH), vegetation height, nest height, and distances to nearest permanent water (DPW) and residence (DRS) in 0–100, 101–300, 301–500, and >500 m categories. In 1990, we measured distance from nest sites to edge (DEG). Edge was defined as the border of any opening >5 m across where vegetation was ≤1 m. Heights of nests, nesting substrates, and controls were estimated with a telescoping pole or clinometer. Distance measurements >500 m were estimated with an optical range finder. A measuring wheel was used for distances <500 m.

If uncolonized stands were in a colonized quarter section (quarter), we gathered data from five controls allocated randomly among the stands. Typically, uncolonized stands were single-row shelterbelts of Siberian elm or low-lying areas dominated by willow, quaking aspen or plains cottonwood. If only one uncolonized stand was present, data for all five controls were drawn from this stand. Data were pooled across colonized quarters, and controls from uncolonized stands were compared against controls from the colonized stands.

Additionally, we made comparisons between colonized and uncolonized quarters. Controls from 70 uncolonized quarters that were surveyed for Common Grackles during 1989–1990 were compared against the combined controls from the colony sites and unused stands in the colonized quarters. Five controls were randomly selected from each of the colonized and uncolonized quarters.

Colony sites and uncolonized stands were classified according to the following habitats: inhabited farmstead shelterbelts, abandoned farmstead shelterbelts, windbreaks (agricultural shelterbelts), towns, potholes, pastures, and miscellaneous. When delineating habitats for uncolonized stands, potholes were considered as habitat only if surrounded by shrubs or trees; no Common Grackle nest sites in cattail (*Typha* spp.) were observed during our two years of surveys in Benson County. Because of the continuous nature of vegetation distributions in towns, all nests in habitat classified as town were attributed to a single colony site.

County-wide habitat availabilities were estimated with the non-mapping technique (Marcum and Loftsgaarden 1980). We selected 200 quarters from our 1989–1990 surveys. Only quarters with vegetation capable of supporting Common Grackle nests were used. Five controls from each quarter were selected by placing an 80-grid, transparent sheet on an aerial photograph of the quarter and randomly selecting grids. Only colonizable habitats were selected, and non-nesting areas (e.g., croplands, roads, and water bodies) were not used.

We tested four null hypotheses: (1) DRS and DPW categories and vegetation were used as nest sites according to their availabilities in the colonies, (2) use of stands in colonized quarters was independent of both vegetation composition and DRS and DPW categories, (3) use of quarters was independent of vegetation and DRS and DPW categories, and (4) colony sites were distributed among the seven habitat categories in proportion to county-wide habitat availabilities. We used *G*-tests for goodness of fit to determine if actual use differed from expected (null) use for habitats, nest-site vegetation, and DRS and DPW categories in the colony sites (Sokal and Rolf 1981). If the *G*-tests were significant ($P \leq 0.05$), preference and avoidance were estimated using the Bonferroni method with an $\alpha = 0.05$ (Neu et al. 1974, Byers et al. 1984, Thomas and Taylor 1990). We used *G*-tests of independence to compare colony sites with uncolonized stands and to compare colonized and uncolonized quarters. Nest-site vegetation used <2% of the time was combined into a miscellaneous category. Vegetation height and DBH and DEG variables could not be transformed to approximate normality; therefore, Wilcoxon two-sample tests were used (Sokal and Rolf 1981). Pairwise comparisons of vegetation heights and DBH were made only for preferred and avoided species as determined by Bonferroni tests.

RESULTS

During our two-year study, we found 202 colonies with 3596 active nests on 177 of the 638 quarters surveyed. Thus, Common Grackles had a mean colony and nest density of 0.49 colonies and 8.81 nests per km^2 in Benson County, with 28% of the quarters occupied. In decreasing order, the most frequently used nesting substrates were blue spruce (N = 924), Siberian elm (N = 819), boxelder (N = 427), caragana (N = 238), and hawthorn (N = 230). Habitat classified as inhabited farmstead shelterbelt

TABLE 1

COMPARISONS[a] OF USE AND AVAILABILITY OF SEVEN HABITATS OCCUPIED BY 202 COMMON GRACKLE COLONIES IN BENSON COUNTY, NORTH DAKOTA, DURING 1989–90

Habitat	Availability (N = 1000) %	Use (N = 202) %	Preference[b]
Windbreak	25.6	24.3	0
Miscellaneous[c]	24.1	11.4	—
Pothole	22.7	6.9	—
Inhabited farmstead	10.9	32.2	+
Pasture	7.7	9.9	0
Abandoned farmstead	7.5	12.9	0
Town	1.5	2.5	0

[a] *G*-test for goodness of fit: G = 90.2, df = 6, $P < 0.0001$.
[b] "+" indicates preference, "—" avoidance, and "0" use according to availability. Preference was determined with Bonferroni confidence intervals ($\alpha = 0.05$) placed on use.
[c] Composition of the miscellaneous habitat category: lakesides (35%), woods (32%), roadsides (14%), ravines (14%), ditches (3%), and railroad easements (2%).

accounted for 57.8% of the nests. Towns, which occurred on five quarters, had the highest mean number of nests (N = 5, $\bar{x}$ = 142.5 nests/km^2, SE = 42.8).

Habitats were not colonized in proportion to their availabilities (G = 90.2, 6 df, $P < 0.0001$). Shelterbelts of inhabited farmsteads were used more frequently than expected, while potholes and miscellaneous habitats (e.g., woods, ravines, railroad easements, and lakesides) were used below expected frequencies (Table 1). Abandoned farmstead shelterbelts, pastures, towns, and windbreaks were used according to availabilities. Colonies were larger (Wilcoxon Two-sample Test: $Z = 4.9$, $P < 0.0001$) on quarters with inhabited farmsteads ($\bar{x}$ = 50.0 nests/km^2, SE = 5.5, N = 65) than on quarters with abandoned farmsteads ($\bar{x}$ = 14.4 nests/km^2, SE = 4.1, N = 26).

The use of quarters depended on plant species composition (G = 251.1, 18 df, $P < 0.0001$). Green ash, blue spruce, wild plum, and hawthorn occurred more frequently on colonized quarters (Table 2). Uncolonized quarters were typified by quaking aspen, plains cottonwood, and willow. We failed to detect differences between controls of colonized and uncolonized quarters for either vegetation heights or DBHs (all Ps > 0.05). Distance categories of controls differed between colonized and uncolonized quarters for farmsteads (G = 379.3, 3 df, $P < 0.0001$) and permanent water (G = 49.8, 3 df, $P < 0.0001$), with more controls on uncolonized quarters >500 m from both of these features.

Use of stands within colonized quarters was dependent on vegetation

TABLE 2

COMPARISONS[a] BETWEEN RANDOMLY SELECTED CONTROL VEGETATION (N = 5) FROM QUARTER SECTIONS COLONIZED BY COMMON GRACKLES AND UNUSED QUARTER SECTIONS

Vegetation	Uncolonized quarter sections (N = 350) %	Colonized quarter section[b] (N = 880) %	Preference[c]
Siberian elm (*Ulmus pumila*)	19.1	16.2	0
Blue spruce (*Picea pungens*)	0.0	3.8	+
Boxelder (*Acer negundo*)	8.6	11.9	0
Hawthorn (*Crataegus rotundifolia*)	1.4	4.2	+ .
Caragana (*Caragana arborescens*)	4.9	5.8	0
Green ash (*Fraxinus pennsylvanica*)	7.7	11.9	+
Chokecherry (*Prunus virginiana*)	6.9	8.4	0
Willow (*Salix* spp.)	21.4	12.5	—
Lilac (*Syringa vulgaris*)	1.1	1.9	0
Wild plum (*Prunus americana*)	0.3	3.0	+
Black poplar (*Populus nigra*)	0.0	1.0	0
Miscellaneous[d]	1.4	1.6	0
Bur oak (*Quercus macrocarpa*)	2.0	0.0	0
Honeysuckle (*Lonicera tatarica*)	0.6	1.5	0
Juneberry (*Amelanchier canadensis*)	0.6	0.8	0
American elm (*Ulmus americana*)	0.9	2.3	0
Aspen (*P. tremuloides*)	11.7	5.1	—
Russian olive (*Elaeagnus angustifolia*)	2.0	2.2	0
Cottonwood (*P. deltoides*)	9.4	5.9	—

[a] *G*-test of independence: $G = 251.1$, df = 18, $P < 0.0001$.
[b] One colonized quarter section consisted only of an abandoned shed surrounded by wheat and was not used in the analysis of vegetation.
[c] "+" indicates preference, "—" indicates avoidance, and "0" indicates use according to availability. Selection was determined with Bonferroni confidence intervals ($\alpha = 0.05$) placed on the vegetation from colonized quarter sections.
[d] Vegetation comprising <2% of the combined categories.

composition ($G = 252.4$, 17 df, $P < 0.0001$) (Table 3). Stands with Siberian elm, green ash, boxelder, caragana, hawthorn, blue spruce, lilac (*Syringa vulgaris*), and American elm (*Ulmus americana*) were more likely to be colonized than stands consisting of willow, plains cottonwood, and quaking aspen. Plains cottonwood had a larger DBH ($P = 0.04$) within colony sites ($\bar{x} = 39.0$ cm, SE = 4.2) than in uncolonized stands ($\bar{x} = 26.2$ cm, SE = 1.9). No differences in heights of control vegetation were detected between colony sites and uncolonized stands (all *P*s > 0.05). The DRS categories were not independent between used and unused stands ($G = 221.4$, 3 df, $P < 0.0001$), with stands of vegetation in the 0–100 m and 101–300 m DRS categories colonized more frequently than stands in 301–500 and >500 m categories. The DPW categories between colony sites and unused stands were independent ($G = 4.7$, 3 df, $P = 0.192$).

TABLE 3

COMPARISON[a] WITHIN QUARTER SECTIONS USED BY NESTING COMMON GRACKLES BETWEEN RANDOMLY SELECTED CONTROLS (N = 5) FROM UNUSED STANDS OF VEGETATION AND COLONIZED STANDS

Species	Unused stands (N = 405) %	Colonized stands (N = 979) %	Preference[b]
Willow	33.6	8.0	—
Cottonwood	13.8	4.3	—
Siberian elm	11.8	17.7	+
Chokecherry	8.6	7.2	0
Aspen	6.2	4.0	—
Green ash	4.0	13.0	+
Boxelder	3.7	14.0	+
Wild plum	3.5	3.8	0
Caragana	3.0	7.0	+
Miscellaneous[c]	2.7	2.4	0
Russian olive	2.5	1.8	0
Hawthorn	2.2	4.8	+
Blue spruce	1.5	3.9	+
Honeysuckle	1.0	1.7	0
Black poplar	0.7	0.9	0
Juneberry	0.7	1.1	0
Lilac	0.2	2.1	+
American elm	0.2	2.2	+

[a] *G*-test of independence: $G = 252.4$, df = 17, $P < 0.0001$.
[b] "+" indicates preference, "—" indicates avoidance and "0" indicates use according to availability. Selection was determined with Bonferroni confidence intervals ($\alpha = 0.05$) placed on the vegetation from colonized stands.
[c] Miscellaneous category consisted of species that formed <2% of the combined categories.

Within colony sites, nesting vegetation was not used according to availability ($G = 203.6$, 17 df, $P < 0.0001$). Blue spruce, Siberian elm, and black poplar were used at greater than expected frequencies, whereas green ash, willow, American elm, quaking aspen, Russian olive, and plains cottonwood were used below expected frequencies (Table 4). The DRS categories were not used in proportion to their availabilities in colony sites ($G = 30.6$, 3 df, $P < 0.0001$). Nest sites ≤100 m from farmsteads were used more frequently than expected; all other DRS categories were used below expected frequencies. The DPW categories were not distributed randomly between controls and nest sites ($G = 8.8$, 3 df, $P = 0.032$); nest sites in the 301–500 m category were used more frequently, while nest sites >501 m from permanent water were used less frequently. Nest-site heights were greater than controls (all *P*s ≤ 0.05) for Siberian elm, blue spruce, green ash, and American elm. The DBHs of nest sites were larger than controls for green ash and Siberian elm, while nest-site

TABLE 4

COMPARISONS[a] WITHIN COLONIES BETWEEN RANDOMLY SELECTED VEGETATION (N = 5) USED BY NESTING COMMON GRACKLES AND RANDOMLY SELECTED UNUSED VEGETATION

Species	Use (N = 799) %	Availability (N = 979) %	Preference[b]
Siberian elm	23.6	17.7	+
Blue spruce	15.5	3.9	+
Boxelder	11.9	14.0	0
Hawthorn	7.5	4.8	0
Caragana	7.5	7.0	0
Green ash	6.3	13.0	—
Chokecherry	5.4	7.2	0
Willow	4.8	8.0	—
Lilac	4.3	2.2	0
Wild plum	3.5	3.8	0
Black Poplar	2.8	0.9	+
Miscellaneous[c]	2.5	2.4	0
Honeysuckle	1.1	1.7	0
Juneberry	1.1	1.1	0
American elm	0.8	2.2	—
Aspen	0.8	4.0	—
Russian olive	0.6	1.8	—
Cottonwood	0.1	4.3	—

[a] *G*-test for goodness of fit: $G = 203.6$, df = 17, $P < 0.0001$.

[b] "+" indicates preference, "—" indicates avoidance and "0" indicates use according to availability. Selection was determined with Bonferroni confidence intervals ($\alpha = 0.05$) placed on use.

[c] Miscellaneous category consisted of substrates that formed <2% of the combined use and availability categories.

DBH was smaller for caragana. In 1990, nest sites were placed randomly with respect to DEG ($Z = 1.6$, $P = 0.12$).

DISCUSSION

Common Grackles prefer shelterbelts of inhabited farmsteads over six other habitat categories. Windbreaks, which offer structurally similar nesting substrates and are often adjacent to farmstead habitats, are used only according to availability. Windbreaks in North Dakota are usually single-rowed structures of Siberian elm and lack the areal extent and species heterogeneity of multi-rowed farmstead shelterbelts. Areal extent and species heterogeneity, however, can not account for the preference shown by Common Grackles for shelterbelts next to inhabited rather than abandoned farmsteads. Both classes of farmstead shelterbelts are of comparable size and species composition. Common Grackles may prefer shelterbelts of inhabited farmsteads because of the increased access to invertebrates. During the 1989 nesting season in Benson County, Common Grackles used invertebrates as their major food (Homan et al. 1994). By establishing colonies near the maintained landscapes of active farmsteads, the birds may improve their foraging success for invertebrates (Yahner 1982). Anthropogenic supplementation of food and water resources (e.g., spilled grains, food, and water for livestock and pets) may further encourage Common Grackle colonization by inhabited farmsteads (Martin 1978: 141).

Habitat use was the broadest measurement of nesting distribution in our study. The vegetation and DRS data show that Common Grackles primarily nest by farmsteads. Excepting hawthorn, the vegetation characteristics associated with Common Grackle colonies were typical of plant species compositions found in multi-rowed farmstead shelterbelts. The use of pastures for colony sites probably cause hawthorn (and to a lesser extent wild plum) to be included with the shelterbelt vegetation. The apparent discrepancies among our vegetation analyses of Common Grackle colony and nest-site use were due to the scalar design of our study. For example green ash, which is avoided by Common Grackles within colony sites, is often planted in farmstead shelterbelts with more preferred nesting substrates (e.g., blue spruce); thus, green ash becomes an indicator of colonized quarters by association with preferred species.

In colony sites, Common Grackles apparently prefer blue spruce, Siberian elm, and black poplar over other plant species. These species are profusely branched, which aids in nest attachment; moreover, their dense foliage probably offers concealment and protection from excessive heat loss or gain. A warmer microclimate may allow for earlier initiation of egg laying (Erskine 1971). The foliage of Siberian elm and black poplar does not appear until May in northcentral North Dakota, and blue spruce (or other dense conifers) is the only nesting substrate favorable for initiating nests in April, the beginning of the breeding season in the state (Stewart 1975).

The rarity of blue spruce in habitats not classified as farmsteads made it impossible to directly separate the influence of human activity from the influence exerted by the structural characteristics of blue spruce. However, the combination of a preferred macrohabitat (inhabited farmstead) with a preferred microhabitat (blue spruce) may present the most favorable environment for nesting Common Grackles. The infrequent use of pothole habitat may have confounded the avoidance shown by nesting Common Grackles for structurally open vegetation, such as quaking aspen and plains cottonwood, but open-structured shelterbelt vegetation (e.g., green ash, American elm, and Russian olive) within colony sites was also used below expected frequencies. Our data support those of Yahner (1982) and Field (1971) who observed that green ash and other open shelterbelt plant species were used infrequently or avoided by nesting Common Grackles. Avoidance is probably a result of the lack of secure nest attachments inherent in open-structured vegetation.

The presence of permanent water probably affects nesting behavior of Common Grackles. Similar observations concerning the association between Common Grackle colonies and water have been made (Erskine 1971, Bent 1958:398–399, Martin 1978:141). However, the birds may be responding to vegetation supported by water rather than to water itself (Erskine 1971). We located 14 colonies by potholes; although this habitat is avoided compared to availability, potholes may influence the association of colonies with permanent water.

Nesting substrate height may also be involved in nest-site selection, with Common Grackles displaying a preference for taller vegetation. Using taller vegetation allows for building nests at greater heights, which may provide for earlier detection of predators (Gutzwiller and Anderson 1987, Bekoff et al. 1987). Additionally, males often use taller vegetation for displaying (Petersen and Young 1950, Wiens 1965, Wiley 1976); these displaying sites may later become nest sites.

Planting more green ash and less blue spruce in farmstead shelterbelts may help reduce nesting densities of Common Grackles in this type of habitat. Structurally open vegetation, including open coniferous species such as ponderosa pine (*Pinus ponderosa*), probably deters nesting because of the lack of suitable attachments for nests. The planting of blue spruce windbreaks at distances >500 m from inhabited residences for reducing soil erosion should not encourage colonization.

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